EASY-TO-PEEL HEAT-SEALING MULTILAYER FILM COEXTRUDED ~~Heat sealable multilayer film with peelable opening behaviour made from coextruded, biaxially oriented polypropylene~~ BIAXIALL ORIENTED POLYPROYLENE

A'

A2

The present invention relates to biaxially oriented, heat sealable, coextruded polypropylene films which are provided by printing during inside-against-outside sealing with a tear-free openable (peelable) longitudinal seam, and to the use thereof for the production of packaging.

BACKGROUND OF THE INVENTION

P'3

Heat sealable packaging films and the use thereof for full wrapping with envelope folds on the end faces and an overlapping longitudinal seam (Fig. 2) have long been known. Plain films without a surface finish, the overlapping sealed longitudinal seams of which may be opened peelably given appropriate settings for sealing temperature, pressure and time have likewise also long been known. Examples which may be mentioned are nitrocellulose lacquer coated cellulose films and acrylic lacquer coated, biaxially oriented polypropylene film (BOPP). Coextruded heat sealable BOPP films, which are preferably used due to lower packaging costs, fail in this respect due to excessively strong sealing or an excessively small temperature range with a sufficiently low seal strength for such applications.

Peelable packages may be produced from BOPP films by providing a cold seal (CS) finish in order to achieve elevated packaging speeds on horizontal form/fill/seal machines. However, this CS technology is not feasible for the full wrap package with envelope folds and a longitudinal seam with outside-against-inside sealing, as shown in Fig. 2, as CS compositions can only be sealed to themselves and may thus only be considered for the inside-against-inside sealed longitudinal and transverse seams of tubular bag packages.

Tear strips offer another option for moderating the deficiency of more difficult opening characteristics of packages made from coextruded BOPP films and one already industrially implemented application, as described in EP 0 577 509 B1,

attenuates the seal strength of the plain film, rendering it unreliable by printing the sealing zones with a sealing-resistant screen-type pattern, such that only the additional use of a tear strip results in the desired opening behaviour fully exposing the package contents. This in particular applies if the finished packages are subjected to thermal post-treatment to improve package appearance resulting in the projecting tab of the tear strip becoming uncontrollably bonded with the wrapping material, so impairing its function as an aid to opening.

The possibility of cancelling out or, in the event of partial coverage, moderating the heat sealability of sealable plain films by means of sealing-resistant lacquers or printing inks is known, but in practice is subject to major, unacceptable variations determined by the natural tolerances of the plain film properties, printing conditions and application weights. The action of such sealing-resistant systems based on sparingly plasticised nitrocellulose or two-component polyurethanes is determined by their spacing function, which is permanent even on exposure to heat and, in principle, deliberately reduces sealing contact (area and pressure) of exposed coextruded BOPP surfaces. Moreover, there is the risk, which cannot reliably be avoided in gravure printing, that the desired residual seal strength of the plain film will be negated by "scumming" (application of ink to unwanted areas).

SUMMARY OF THE INVENTION

The object accordingly arises of reliably providing low cost, coextruded BOPP films, which as a result of their production process exhibit unsuitably strong sealing properties, with the desired peelable sealing properties in the course of the printing process without the stated disadvantages, such that packages produced therefrom, preferably full wrap packages according to Fig. 2, may be opened without a tear strip sufficiently easily and as far as possible without tearing and that seal strength is largely kept constant over a wide tolerance range allowing for technically unavoidable raw material variations as well as variations in printing conditions, sealing temperatures and application weights.

This has been achieved according to the invention by printing conventional commercial, coextruded BOPP films by means of register-controlled gravure

printing, preferably on the electrically pretreated side in a sealing area which has been left ink-free, with a thermoplastic lacquer in a screen-type pattern, which lacquer is itself only weakly sealable to coextruded BOPP and contains at least one polyvinyl butyral (PVB) or at least one ethylene/vinyl acetate copolymer (EVA copolymer) as the feature-determining component. This specific selection of the lacquer ensures that the spacing action progressively declines as softening proceeds with rising temperatures and increasingly permits the coextruded BOPP surfaces to come into sealing contact.

BRIEF DESCRIPTION OF THE DRAWINGS

Seal strength and peeling behaviour in inside-against-outside sealing (a/b sealing) may purposefully be controlled by the design of the screen used during printing.

Particularly suitable screens are shown in Table 3. It is possible here both to provide a uniform screen over the length and width of the sealing area and to provide, within the possibilities of the gravure process, a variable screen over the length and/or width of the sealing area in order to met specific requirements with regard to seam strength and/or peel behaviour. In accordance with the described screening, the lacquer is applied with partial coverage and preferably with full-tone gravure depth.

The lacquer used comprises conventional commercial ink/lacquer systems with polyvinyl butyrate (PVB), as widely used for reverse printing on coextruded BOPP surfaces (e.g. 15-020613-4, series MX 31, Siegwerk) or ethylene/vinyl acetate copolymers (EVA copolymer, e.g. 10-612764-0 W, Siegwerk) as the feature-determining solid component. It is also possible to use mixtures of two or more PVB lacquers or two or more EVA copolymer lacquers.

The (dry) lacquer application rate for PVB lacquers is preferably 0.1 to 1.7 g/m^2, in particular 0.8 to 1.2 g/m^2. The (dry) lacquer application rate for EVA copolymer lacquers is preferably 0.1 to 2.5 g/m^2, in particular 1.0 to 1.5 g/m^2.

The film according to the invention preferably comprises a coextruded BOPP film which has been printed by register-controlled gravure printing on the electrically pretreated side outside the sealing areas which have been left ink-free.

Coextruded BOPP films, which as plain films exhibit excessively strong seals which tear on separation, may be obtained in a form exhibiting weaker and peelable seals by means of the print finish according to the invention.

It was not to have been expected either that an ethanol-thinnable PVB lacquer printed according to the invention would seal sufficiently strongly to unpretreated coextruded BOPP or, when a water-thinnable EVA copolymer lacquer was used, that no unwanted material tearing on separation of the seam would start from the remaining lacquer-free seal points on the coextruded surface, despite a sufficiently strong seal, but that instead tear-free peeling would occur in both cases and that it would be possible to dispense with tear strips as an aid to opening.

The film according to the invention is preferably produced by multipurpose printing of conventional commercial, largely standardised, coextruded BOPP films by gravure or flexographic printing, preferably on conventional multicolour gravure presses with register control using engraved cylinders with cells, wherein front or reverse printing inks suitable for coextruded BOPP are used in combination with one of the lacquers according to the invention in the ink-free area. The film is then finally cut in accordance with customer requirements on conventional commercial roll cutting machines with lateral edge control. The arrangement of the ink-free areas is determined by the type of package which is to be produced from the coextruded BOPP film. Preferred ink-free areas are those according to Fig. 1 which are arranged as continuous strips along both edges of the reel in machine direction or as uniformly spaced transverse strips arranged transversely to the machine direction of the reel.

The present invention also provides packages produced from the films according to the invention, in particular full wrap packages which have no additional tear aids and which may easily be opened without tearing.

The following Examples are intended to illustrate the invention in greater detail.

The properties of relevance to the intended purpose of the films according to the invention are determined by testing low pressure seal strength (LPSS) over a temperature range compatible with the film (sealing curve) in order to evaluate their suitability for wrapping applications.

Low pressure seal strength is the force in N, relative to the test strip width of 15 mm, which is required to separate a seal seam produced under defined conditions (pressure, temperature, time).

Sealing conditions: Pressure 0.35 N/cm², time 0.5 sec, temperature 105 to 150°C in 5 Kelvin intervals.

Measuring devices: Low pressure sealer from Brugger, with 20*50 mm² sealing bars, sized, 5 instances at different temperatures. 5 instances with counterweights of a bearing area of 25*30 mm² to which 2 to 3 mm thick felt has been stuck.

Test strip cutter: cutting width 15 mm. Tensile tester with 10 N measurement range and draw speed of 100 mm/min.

Qualitative evaluation: In addition to a value of >0.5 N/15 mm, which may be considered acceptable for practical wrapping purposes, as an essential condition, tear-free, peeling separation according to the invention was included in the evaluation as a sufficient condition and the temperature range exhibiting the desired sealing behaviour was determined (Table 1). It is found that sealing values of

>1.5 N/15 mm give rise to unwanted tearing of the material on separation of the seam.

Example 1

LPSS values, outside-against-inside, of between 0.5 and 1.5 N/15 mm were achieved from temperatures of 125°C with tear-free separation by multicolour reverse gravure printing onto the electrically pretreated side (subsequently inside of package) of a conventional commercial 20 µ gauge coextruded BOPP film (Walothen® C20EHS from Wolff Walsrode AG) with widely used ethanol-thinnable polyvinyl butyral inks (PVB) in the decorative area and polyvinyl butyral lacquer (15-020613-4, series MX 31 from Siegwerk Druckfarben GmbH & Co. KG) in the ink-free longitudinal seam area using various conventional gravure screens, 60/1, 70/1, 70/4 and 80/1 (Table 2). Depending upon the screen, the width of the usable temperature range varies and, in the case of preferred forms (60/1 and 70/4), entails precise temperature control of the sealing tools in the wrapping plant (Table 1).

Example 2

By replacing the PVB lacquer used in Example 1 with a commercial water-thinnable sealing lacquer based on an aqueous dispersion of saponified synthetic resins (ethylene/vinyl acetate copolymer) in the form of sealing lacquer 10-612764-0W from Siegwerk Druckfarben GmbH & Co. KG, which has proven sealability to unpretreated coextruded BOPP, it proved possible to achieve the desired LPSS values of between 0.5 and 1.5 N/15 mm and peeling separation behaviour over a wide temperature range (Table 1).

Comparative Example 1

In comparison with Examples 1 and 2, the LPSS (a/a) of the unpretreated, unprinted plain film at a value of = 2.5 N/15 mm is too high and it is not possible to separate the seam without tearing (Table 1).

Comparative Example 2

The LPSS (a/b) of the unpretreated side against the pretreated side of the unprinted plain film likewise does not exhibit a usable temperature profile. Although, as expected, the values are lower than the LPSS (a/a) in Comparative Example 1, the temperature range with seal strengths of 0.5 to 1.5 N/15 mm, which permit tear-free separation, is too narrow (Table 1).

Comparative Example 3

By way of comparison with the prior art, the desired low LPSS values are frequently, but not reliably, achieved by multicolour reverse gravure printing on a film as described in Example 1 but of a gauge of 25 µ with various ink systems depending upon the application, such as ethanol-thinnable polyvinyl butyral based ground metal ink, ethanol/ethyl acetate-thinnable NC based coloured inks, ethyl acetate-thinnable two-component NC ester white ink in the decorative area and two-component PU lacquer (sealing-resistant) as the screen (Table 3, Y) in the ink-free longitudinal seam zone. In some cases, the seal was inadequate in the temperature range of 125 to 135°C, which is of particular practical relevance (Table 1). This result reflects the unsatisfactory nature of the prior art.

Table 1: Low pressure sealing results from the Examples

Example	1				2			Comparative Example 1	Comparative Example 2	Comparative Example 3
Gravure screen	60/1	70/4	80/1	70/1	Squares, approx. 10% coverage	Squares, approx. 50% coverage	Squares, approx. 90% coverage	Plain film	Plain film	Squares, approx. 50% 2-component lacquer
LPSS N/15 mm	a/b	a/b	a/b	a/b	a/bx	a/by	a/bz	a/a	a/b pretreated	a/by
110°C	0	0	0	0	0	0	0	0	0	0
115°C	0	0	0	0	0	0	0	0.4	0.5	0
120°C	0.2	0.2	0.2	0.3	0.2	0.3	0.3	1.4	0.9	0
125°C	1.1	1.3	0.7	0.8	0.5	0.6	0.5	2.9	1.0	0
130°C	1.5	1.5	1.3	1.9	0.6	0.8	0.6	2.9	2.1	0
135°C	1.5	1.4	1.8	1.7	0.6	0.6	0.5	2.7	2.2	0.2
140°C	2.3	1.8	1.8	2.1	0.6	0.8	0.8	2.8	2.1	0.3
145°C	2.1	1.9	2.0	2.3	1.2	1.2	0.9	2.7	2.2	0.6
150°C	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Sealing values of 0.5 to 1.5 N/15 mm (grey background), usable range with tear-free seam separation (verification)

a/a = unprinted side of film sealed to itself (blank test)

a/b = unprinted side of film against side finished according to the invention (typical sealing for wrapped packages)

a/b prt. (electrically pretreated), without influence of printing ink

[illegible]

Table 2: Characterisation of printing cylinders used (gravure printing with HelioKlischograph manufactured by Hell)

Gravure screen	60/1 (Example 1)	70/4 (Example 1)	80/1 (Example 1)	70/1 (Example 1)	70/0 (Example 2)
Cells/cm	60	70	80	70	70
Screen angle	1	4	1	1	0
Transverse diagonal (μ)	172	108	129	146	180
Puncture (μ)	22	16	18	22	22

Table 3: Explanation of squares in Table 1, Example 2 and Comparative Example 3, and of differentiation into zones X, Y and Z, with uniform 70/0 gravure screen

X	Y	Z
6:1	6:1	10:1 magnified

Dimensions in mm, dark areas are printed.